CANDIDATE'S NUMBER

(For the use of the Department only)

Physics 30
1967

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DEPARTMENT
EDUCATION ALBERTA

HIGH SCHOOL AND UNIVERSITY MATRICULATION
EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1967

PHYSICS 30

Time — 3 hours.

Total Possible Mark — 155.

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE QUESTIONS CAREFULLY.

Mathematical tables, slide rules and geometry sets may be used.

Complete solutions must be shown for all problems.

Rough and finished work may be done in either soft pencil or blue or black ink (pen or ballpoint).

DO NOT FOLD THIS BOOKLET.

Place your test booklet in the answer envelope in such a way that the UPPER LEFT HAND CORNER OF THE BOOKLET (Candidate's Number) shows through the SLASHED CORNER of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

Constants:

$g = 980$ cm/sec^2 or 32 ft/sec^2
$J = 4.2$ joules/cal or 778 ft lb wt/BTU
1 H.P. = 550 ft lb wt/sec or 746 watts
Specific heat for aluminum = 0.20
Latent Heat of fusion of ice = 80 cal/gm

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FOR ROUGH WORK

(No marks given for work in this space)

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QUAECUMQUE VERA

Values

4 **1.** A river flows at 8.0 mph. A boat which travels 12 mph in still water starts at A and travels down stream to B a distance of 10 mi from A. If the boat then returns to A without stopping, find the average ground velocity for the entire trip.

2. An object, initially at rest, is given an acceleration of 20 cm/sec/sec. A second object is set in motion with an acceleration of 80 cm/sec/sec from the same place and in the same direction but 4.0 sec later than the first object.

3 (a) How far apart are they after the second object has been in motion for 6.0 seconds?

4 (b) How long after the second object was started are the two objects both the same distance from the starting point?

[OVER]

FOR ROUGH WORK

(No marks given for work in this space)

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Values

4 **3.** Using combinations of the units, gram for mass, centimeter for length and second for time, supply the correct units for each of the following terms:

(a) Acceleration ....

(b) Momentum ....

(c) Impulse ....

(d) Power ....

3 **4.** A force of 5.00 gm wt and one of 900 dynes act on a mass of 200 gm in opposite directions. Calculate the acceleration produced.

2 **5.** An object of mass 64 lb, initially at rest, is given a blow which gives the object a velocity of 10 ft/sec. Calculate the impulse of the force.

FOR ROUGH WORK

(No marks given for work in this space)

Values

2 **6.** Two identical pendulums are located at the same place. Explain how it would be possible to give one a different period of oscillation than the other.

5 **7.** A 150 lb man sits in a 250 lb boat in which there is a 25 lb rock. The man throws the rock out the back of the boat with a horizontal velocity of 20 ft/sec relative to the boat. Neglecting friction what would be the increase in velocity of the boat?

[OVER]

FOR ROUGH WORK

(No marks given for work in this space)

Values

8. A screw-jack has 5 threads to the inch and is operated by a handle 14 inches long. It is used to lift a 900 lb wt load and under these conditions has an efficiency of 30%.

2 (a) What is the velocity ratio?

2 (b) What is the force ratio?

2 (c) What effort would be required to lift this load?

5 **9.** How many cubic feet of water of density 62.5 lb/ft^3 can be raised from a well 132 ft deep in 3 hr by an 8 hp engine which has an efficiency of 75%?

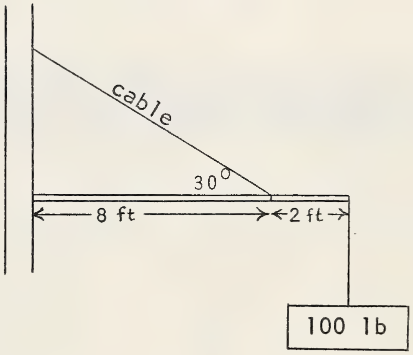
FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **10.** Four forces act at a point. They are 13 lb wt North, 10 lb wt East, 9.0 lb wt South and 7.0 lb wt West. Find the equilibrant of the forces in both magnitude and direction.

4 **11.** A uniform boom 10 ft long is held in a horizontal position by a cable which makes an angle of 30° to the horizontal, as shown in the diagram at the right. If the boom weighs 20 lb wt, find the tension in the cable when a 100 lb object is attached to the end of the boom.



FOR ROUGH WORK

(No marks given for work in this space)

Values

5 **12.** An isosceles triangle is constructed with light wires two of which are 10 in long and one 16 in long. Objects weighing 6 lb are placed at each of the two identical corners and a 60 lb object is placed at the third corner. Neglecting the weight of the wires, calculate the center of gravity of the combined object.

4 **13.** A vessel with a horizontal cross-section of 80.0 cm^2 is filled to a depth of 60.0 cm with a liquid of specific gravity 1.60. A 40.0 cm^3 object of specific gravity 0.40 is placed in the liquid. Neglecting air pressure what would be the total pressure at the bottom of the container?

FOR ROUGH WORK

(No marks given for work in this space)

Values

14. A uniform object 60 cm long and 10 cm^2 in cross-section floats in a liquid of specific gravity 0.80 with 40.0 cm of its length submerged.

2 (a) What is the weight of the object?

3 (b) What additional force would be required to sink the object in water?

3 **15.** Suppose an imaginary thermometer has its fixed points (freezing point and boiling point of water) at 10 and 160 degrees. If the actual temperature is 80° C, what would be the temperature reading on this imaginary thermometer?

[OVER]

FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **16.** A solid object has a volume of 800 cm^3. Upon heating the object through an increase in temperature of 150° C its volume increased by 0.30%. Calculate its coefficient of area expansion.

6 **17.** An iron container has a volume of 5.00 gal at 40° C. If you are supplied with 5.01 gal of glycerine also at 40° C, find the temperature at which the glycerine will exactly fill the container. The coefficient of linear expansion of iron is 0.000011/° C and the coefficient of volume expansion of glycerine is 0.00050/° C.

FOR ROUGH WORK

(No marks given for work in this space)

Values

3 **18.** The volume of a mass of gas is 50 ft^3 at S.T.P. What will be the pressure if the temperature is lowered to –182° C and the volume is decreased to 25 ft^3 ?

3 **19.** A 200 gm object of specific heat 0.22 is added to a second object of water equivalent 50 gm. What is the thermal capacity of the combined object?

4 **20.** One hundred gm of aluminum at 100° C are placed in a 150 gm calorimeter of specific heat 0.09 containing 200 gm of water at 20° C. Find the final temperature. (The specific heat of aluminum is 0.20)

[OVER]

FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **21.** Two gm of gasoline were burnt in a thick steel vessel of mass 8.0 kg which was immersed in 2.0 kg of water. The total rise in temperature of water and vessel was found to be 12 centigrade degrees. Find the calorific value of gasoline. (The specific heat of steel is 0.10)

22. Eighty ergs of work are required to push a charge of + 16 esu from a point A of 60 esu potential to point B.

2 (a) What is the potential of point B?

2 (b) If points A and B were twice as far apart but at the same potentials how much work would be required to move a charge of +8 esu from A to B?

FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **23.** Two point charges of +360 esu and –160 esu are placed 10 cm apart in a medium of dielectric constant 2. What is the electric field at a point 6 cm from the +360 charge and 4 cm from the –160 charge?

2 **24.** When a potential difference of 1000 volts is applied to the plates of a condenser the condenser receives a charge of 0.4×10^{-8} coulomb. Calculate the capacity in microfarads.

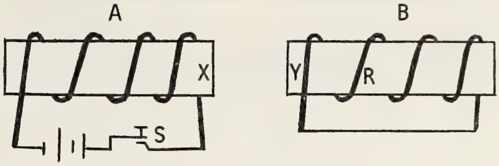
3 **25.** A 100 cm^2 surface is to be coated with copper to a depth of 0.1 mm. Calculate the time required if a steady current of 2 amps is provided. The atomic weight of Cu^{++} is 64 and the density of copper is 9.0 gm/cm^3. (96,500 coulombs liberate 1 gm equivalent wt.)

FOR ROUGH WORK

(No marks given for work in this space)

Values

26.



The figure above shows two coils of insulated wire A and B, each wound around an iron core.

1 (a) if switch S is closed the magnetic polarity of end X of coil A would be ....

1 (b) If switch S is closed and coil A is moved towards coil B the magnetic polarity at end Y of coil B would be ....

1 (c) If switch S is held closed for several seconds and there is no relative motion between the two coils, the current in coil B would be ....

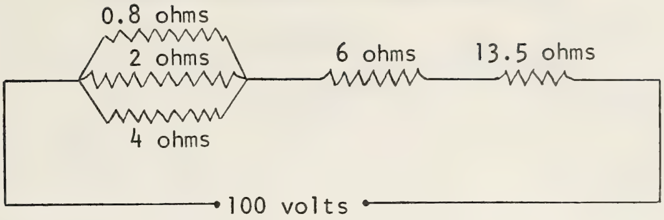
1 (d) At the instant switch S is opened the direction of the current at point R of coil B would be ....

FOR ROUGH WORK

(No marks given for work in this space)

Values

27.



2 (a) What is the total resistance of the circuit shown above?

1 (b) What current flows through the 6 ohm resistor?

2 (c) What current flows through the 4 ohm resistor?

28. A step-down transformer has 100 turns in the primary and 20 turns in the secondary. The input voltage and current are 600 volts and 10 amperes respectively. The efficiency of the transformer is 95%.

2 (a) What is the output voltage?

2 (b) What is the output power?

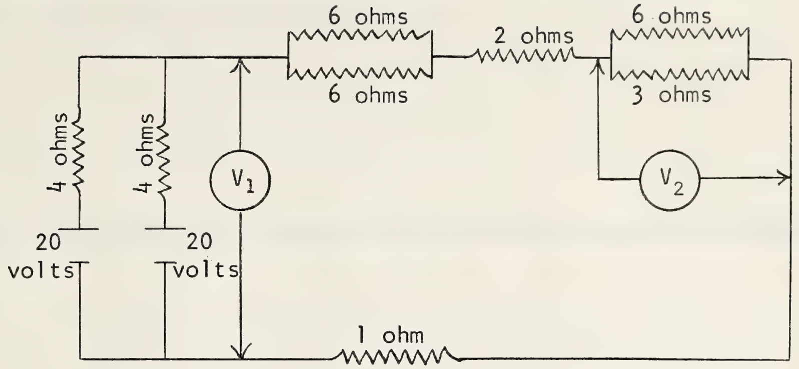
2 (c) What is the output current?

FOR ROUGH WORK

(No marks given for work in this space)

Values

29.



Two identical cells of EMF 20 volts and internal resistance 4 ohms are connected into a circuit as shown in the diagram.

1 (a) What is the total EMF of the circuit?

4 (b) What is the current in the 1 ohm resistor?

2 (c) What is the reading of voltmeter V_1?

2 (d) What is the reading on voltmeter V_2?

FOR ROUGH WORK

(No marks given for work in this space)

Values

30. A 20-hp motor takes a current of 40 amperes at 450 volts.

3 (a) What is the efficiency of the motor?

2 (b) What is the cost of running the motor for 20 hr if electricity costs 3 cents/kw-hr?

31. Answer the following questions from your knowledge of the electric motor as studied in Experiment 20.

1 (a) If, after the motor was running, the polarity of one bar magnet was reversed the effect on the motor would be

....

1 (b) If, after the motor was running, the bar magnets were moved apart the effect on the motor would be

....

2 (c) Draw a diagram showing how to use the electromagnetic field coil attachment instead of the bar magnets. The motor is to be shunt wound.

FOR ROUGH WORK

(No marks given for work in this space)

Values

32. Two identical 4 lb objects are placed at a height of 16 ft with a horizontal separation of 10 ft. The objects are then projected at each other with a horizontal velocity of 10 ft/sec each.

4 (a) Neglecting air resistance where will the objects meet?

4 (b) If the objects stick together upon collision what will be their combined momentum just before striking the ground?

[OVER]

FOR ROUGH WORK

(No marks given for work in this space)

Values

33. A 10 lb object is fired from ground level with a vertical velocity of 72 ft/sec and a horizontal velocity of 30 ft/sec. Neglecting air resistance find:

3 (a) the initial KE of the object

2 (b) the KE of the object at its maximum height

3 (c) the KE of the object when it is 80 ft above the ground

FOR ROUGH WORK

(No marks given for work in this space)

Values

6 **34.** A 20 lb object is at rest on a rough horizontal plane. A horizontal force is applied to the object with increasing magnitude until the object just starts to move. The magnitude of the force is then held constant at this value. How far will the object go in 10 sec if the coefficient of static friction is 0.25 and the coefficient of sliding friction is 0.20?

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